

WHAT IS CLAIMED IS:

1 1. An embolectomy catheter for removing a blood clot or other such
2 obstructive matter from a blood vessel, the catheter comprising:

3 an elongate flexible catheter body having a proximal end, a distal end, an
4 inner tube, and a guidewire lumen a part of which extends longitudinally through
5 the inner tube, the guidewire lumen being sized to receive a guidewire therein
6 and being open on its distal end to permit the guidewire so received to project
7 distally from the distal end of the catheter body; and

8 a clot removal device on the inner tube, the clot removal device being
9 deployable in a first state to a radially expanded configuration.

1 2. The catheter of claim 1, further including an outer tube arranged to
2 surround and constrain the clot removal device about the inner tube in a second state
3 prior to its deployment to the first state, the catheter body and clot removal device in the
4 second state being passable through the clot.

1 3. The catheter of claim 2, wherein the inner and outer tubes are relatively
2 axially displaceable to cause the clot removal device to transition between the first and
3 second states.

1 4. The catheter of claim 3, wherein the inner and outer tubes extend co-
2 axially substantially the entire length of an insertion portion of the catheter body.

1 5. The catheter of claim 4, further including a handle attached to a proximal
2 end of the insertion portion, and an actuator on the handle for proximally displacing the
3 outer tube with respect to the inner tube.

1 6. The catheter of claim 5, further including an infusion port provided on the
2 handle in fluid communication with an annular space defined between the inner and
3 outer tubes.

1 7. The catheter of claim 6, wherein the infusion port is mounted to a slide
2 that is axially displaceable on the handle, and wherein the catheter body outer tube is
3 attached to a distal end of the slide to receive fluid from the infusion port.

1 8. The catheter of claim 2, further including a distal tip attached to a distal
2 end of the inner tube, the distal tip having a tapered distal surface defining the distal
3 end of the catheter body, the tapered distal surface facilitating passage of the catheter
4 body through the clot.

1 9. The catheter of claim 8, wherein the distal tip defines a proximal mouth
2 for receiving a short length of the outer tube, wherein the distal end of the outer tube
3 is thereby prevented from catching on the clot as the catheter body passes
4 therethrough.

1 10. The catheter of claim 9, wherein the outer tube is relatively retractable in
2 the proximal direction with respect to the inner tube, the clot removal device radially
3 expanding into the first state in a region between the retracted outer tube and the distal
4 tip.

1 11. The catheter of claim 10, wherein the clot removal device has a proximal
2 end and a distal end, the distal end being attached to the inner tube and the proximal
3 end being free to slide axially over the inner tube, the proximal end of the clot removal
4 device being axially displaced away from the distal end within the outer tube to
5 longitudinally stretch and radially constrict the device in the second state.

1 12. The catheter of claim 11, wherein the clot removal device comprises a
2 plurality of separate wires each attached at their distal ends to the inner tube and being
3 looped about the inner tube at their proximal ends.

1 13. The catheter of claim 11, further including a sliding marker band disposed
2 about the inner tube and configured to slide with the proximal end of the clot removal
3 device to indicate the transition between the first and second states.

1 14. The catheter of claim 13, further including a fixed marker band attached
2 about the inner tube distally with respect to the clot removal device, the relative spacing
3 between the fixed marker band and the sliding marker band indicating the transition
4 between the first and second states.

1 15. The catheter of claim 1, wherein the catheter further comprises a handle
2 and an insertion portion of the catheter body extending distally from handle, the
3 insertion portion being defined by the inner tube and a co-axial outer tube extending

4 substantially to the distal end of the catheter body, the clot removal device being
5 radially constricted about the inner tube in a second state prior to its deployment to the
6 first state, the catheter body and clot removal device in the second state being passable
7 through the clot, wherein the inner and outer tubes are relatively axially displaceable
8 to cause the clot removal device to transition between the first and second states.

1 16. The catheter of claim 15, wherein the insertion portion becomes more
2 flexible in a distal direction from the handle.

1 17. The catheter of claim 16, wherein the catheter body has a size of between
2 about 1-5 French at its distal end.

1 18. The catheter of claim 16, wherein both the inner and outer tubes become
2 more flexible in a distal direction from the handle.

1 19. The catheter of claim 18, wherein both the inner and outer tubes include
2 discrete segments that become more flexible in a distal direction from the handle.

1 20. The catheter of claim 19, wherein at least one of the inner and outer tubes
2 includes a reinforced segment adjacent the handle.

1 21. The catheter of claim 15, further including an actuator on the handle for
2 proximally displacing the outer tube with respect to the inner tube.

1 22. The catheter of claim 21, further including an infusion port provided on the
2 handle in fluid communication with an annular space defined between the inner and
3 outer tubes.

1 23. The catheter of claim 22, wherein the infusion port is mounted to a slide
2 that is axially displaceable on the handle.

1 24. The catheter of claim 23, further including an inner hypotube extending
2 substantially the length of the handle and attached at its distal end to the catheter body
3 inner tube, and a guidewire introducer on a proximal end of the handle leading to the
4 lumen of the inner hypotube, wherein the slide includes a throughbore receiving the
5 hypotube.

1 25. The catheter of claim 24, wherein the infusion port is in fluid
2 communication with the throughbore, and wherein the catheter body outer tube is

3 attached to a distal end of the slide co-axially with respect to the throughbore for
4 receiving fluid from the infusion port.

1 26. The catheter of claim 1, wherein the clot removal device has a proximal
2 end and a distal end, the distal end being attached to the inner tube and the proximal
3 end being free to slide axially over the inner tube, the proximal end of the clot removal
4 device being axially displaced away from the distal end within the outer tube to
5 longitudinally stretch and radially constrict the device in a second state prior to its
6 deployment to the first state, the clot removal device in the second state being passable
7 through the clot.

1 27. The catheter of claim 26, further including a sliding marker band disposed
2 about the inner tube and configured to slide with the proximal end of the clot removal
3 device to indicate the transition between the first and second states.

1 28. The catheter of claim 27, further including a fixed marker band attached
2 about the inner tube distally with respect to the clot removal device, the relative spacing
3 between the fixed marker band and the sliding marker band indicating the transition
4 between the first and second states.

1 29. The catheter of claim 26, wherein the clot removal device comprises a
2 plurality of separate wires each attached at their distal ends to the inner tube and being
3 looped about the inner tube at their proximal ends, the wires being spring biased to
4 radially expand if unconstrained, the catheter body further including an outer tube
5 arranged to surround and constrain the clot removal device about the inner tube in the
6 second state, the inner and outer tubes being relatively axially displaceable to release
7 the wires.

1 30. The catheter of claim 29, wherein the separate wires are helically wound
2 about the inner tube, the spring-biased helical wires forming a radially expanded nest
3 configuration upon their release from within the outer tube.

1 31. A system including the catheter of claim 1, and further including a
2 guidewire received in the guidewire lumen and having a length sufficient to extend from
3 the proximal end of the catheter body and project from the distal end.

1 32. The system of claim 31, wherein the guidewire is an infusion guidewire.

1 33. An embolectomy catheter for removing a blood clot or other such
2 obstructive matter from a blood vessel, the catheter comprising:

3 an elongate flexible catheter body having a proximal end, a distal end, an
4 inner tube, and an outer tube terminating just short of a distal end of the catheter
5 body;

6 a clot removal device on the inner tube, the clot removal device being
7 initially collapsed and constrained in its collapsed configuration by a portion of
8 the outer tube;

9 a distal tip of the catheter body located on the inner tube and adapted to
10 pass through a blood clot to be removed; and

11 wherein the outer tube is axially retractable to remove the constraint on
12 the clot removal device such that the clot removal device may radially expand
13 to a deployed configuration.

1 34. The catheter of claim 33, wherein the outer tube extends distally within
2 a proximal mouth of the distal tip prior to being retracted.

1 35. The catheter of claim 33, wherein the inner tube is reinforced along its
2 entire length.

1 36. The catheter of claim 35, wherein the inner tube is more flexible at its
2 distal end than at its proximal end.

1 37. The catheter of claim 36, wherein the inner tube includes a proximal
2 reinforced segment and a distal reinforced segment, and wherein the proximal segment
3 has reinforcement of higher density than in the distal segment.

1 38. The catheter of claim 33, wherein the catheter body becomes more
2 flexible in a direction from the proximal end to the distal end.

1 39. The catheter of claim 38, wherein the catheter body has a size of between
2 about 1-5 French at its distal end.

1 40. The catheter of claim 38, wherein both the inner and outer tubes include
2 discrete segments that become more flexible in a direction from the proximal end to the
3 distal end.

1 41. The catheter of claim 40, wherein the inner tube is reinforced along its
2 entire length, and includes a proximal reinforced segment and a distal reinforced
3 segment, and wherein the proximal segment has reinforcement of higher density than
4 in the distal segment.

1 42. The catheter of claim 38, wherein a portion of the outer tube that
2 constrains the clot removal device in its collapsed configuration has a substantially
3 lower column strength than a portion of the inner tube about which the clot removal
4 device is mounted.

1 43. The catheter of claim 33, further including a handle attached to a proximal
2 end of the insertion portion, and an actuator on the handle for proximally displacing the
3 outer tube with respect to the inner tube.

1 44. The catheter of claim 43, further including an infusion port provided on the
2 handle in fluid communication with an annular space defined between the inner and
3 outer tubes.

1 45. The catheter of claim 44, wherein the infusion port is mounted to a slide
2 that is axially displaceable on the handle.

1 46. The catheter of claim 43, further including a slide that is axially
2 displaceable on the handle and an inner hypotube extending substantially the length
3 of the handle and attached at its distal end to the catheter body inner tube, and a
4 guidewire introducer on a proximal end of the handle leading to the lumen of the inner
5 hypotube, wherein the slide includes a throughbore receiving the hypotube.

1 47. The catheter of claim 33, wherein the clot removal device has a proximal
2 end and a distal end, the distal end being attached to the inner tube and the proximal
3 end being free to slide axially over the inner tube, the proximal end of the clot removal
4 device being axially displaced away from the distal end within the outer tube to
5 longitudinally stretch and radially constrict the device in a second state prior to its
6 deployment to the first state, the clot removal device in the second state being passable
7 through the clot.

1 48. The catheter of claim 47, further including a sliding marker band disposed
2 about the inner tube and configured to slide with the proximal end of the clot removal
3 device to indicate the transition between the first and second states.

1 49. A system including the catheter of claim 33, wherein the inner tube
2 defines a guidewire lumen sized to receive a guidewire therein, the guidewire lumen
3 being open on its distal end to permit the guidewire so received to project distally from
4 the distal end of the catheter body, and further including a guidewire received in the
5 guidewire lumen and having a length sufficient to extend from the proximal end of the
6 catheter body and project from the distal end.

1 50. The system of claim 49, wherein the guidewire is an infusion guidewire.